ROOT Notebook with Org

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1 Introduction

In the recent ROOT v6.06 announcement we got the interesting news that one can now run ROOT from an Jupyter (ne' ipython) notebook. The notebook feature forges a connection between a web browser UI and a backend kernel of which ROOT is one. The notebook can be written to a Markdown document. This document is strikingly similar to, although not as semantically rich as, an Org document. The document you are reading is an attempt to provide a simple, if verbose, "Org Notebook" example.

2 Graphics format

Org supports many graphics formats for inline viewing in Emacs or for export. Different export formats "like" different graphics formats. To support exporting to both PDF (via LATEX) and HTML in the most simple way, we have ROOT produce plots in SVG. SVG is native for most HTML renderers but requires a few tweaks for LATEX. ROOT's SVG also may have some Unicode characters that cause problems with LATEX. In this example we deal with these issues by adding the following Org headers:

```
#+LATEX_HEADER: \usepackage[clean,pdf]{svg}
#+LATEX_HEADER: \DeclareUnicodeCharacter{2212}{-}
#+LATEX_HEADER: \setsvg{pretex=\tiny}
```

The svg package we use here will convert SVG to PDF on the fly. Take note of the ROOT-specific info in the svg package documentation. To allow the automatic SVG conversion, pdflatex needs to be told it is okay to run external programs. You can either export the Org document to LATEX (C-c C-e 1 1) and run pdflatex yourself or you can add --shell-escape to

the org-latex-pdf-process variable. You can set the variable directly or customize it. Mine looks like this:

```
("pdflatex --shell-escape -interaction nonstopmode -output-directory %0 %f" pdflatex --shell-escape -interaction nonstopmode -output-directory %0 %f" pdflatex --shell-escape -interaction nonstopmode -output-directory %0 %f")
```

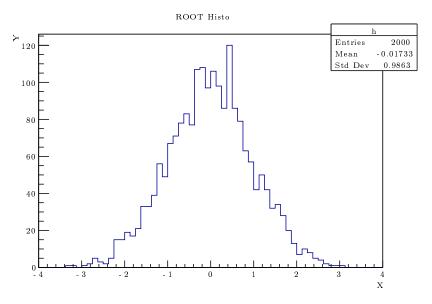
3 The Example

Start with some general ROOT plotting setup. This Python source block exports only the code and has no results. We give it the :session argument so that the instance of Python is used for all subsequent code blocks.

```
import ROOT
# set batch so we don't have a TCanvas pop up
ROOT.gROOT.SetBatch(True);
c = ROOT.TCanvas("c")
```

Next, we make a histogram, fill it, draw it and print the canvas to the SVG file. Shown in the Org source for the document you are currently reading, the :session flag is given and thus the canvas variable c defined above can be used here. Other directives tell Org that both code and results are exported and that the result of the code block is to interpreted as a file name.

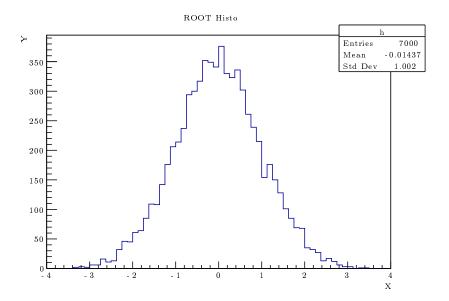
```
h = ROOT.TH1F("h","ROOT Histo;X;Y",64,-4,4)
h.FillRandom("gaus",2000);
h.Draw();
fname = "output_0_1.svg"
c.Print(fname)
fname
```



If you are reading this document from its Org sources in Emacs you may wish to toggle inline images with C-c C-x C-v to see the result above as a figure instead of just the file name.

Next, we do some further operation on the histogram defined above and draw it again to a second file. Note the increase in statistics.

```
h.FillRandom("gaus")
h.Draw()
fname = "output_0_2.svg"
c.Print(fname)
fname
```



4 Exporting

You can export this Org file to PDF via LATEX or to HTML with just a few key strokes. You can further have the result load into a PDF or HTML viewer. Try:

C-c C-e 1 1 export to LATEX

C-c C-e 1 p as above plus run pfdlatex to make a PDF

C-c C-e 1 o as above plus open the PDF file in a viewer

C-c C-e h h export to HTML

C-c C-e h o as above plus open the HTML file in a browser

5 Summary

The addition of ROOT as a backend kernel for Jupyter is a nice development. Through Python source blocks and ROOT's PyROOT binding one has for a while had "Org Notebooks". For those that prefer to work inside Emacs and especially with Org markup, this provides a full featured alternative. With some nominal setup, the Org file may be exported to both LATEX/PDF and HTML using SVG graphics.